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for producing reliable estimates or indices.

(ii) Measurement of age structures, life table statistics, or age structure models generally will not provide satisfactory measurement of changes due to a discharge of oil or release of a hazardous substance unless there is clear evidence that the oil or hazardous substance has differentially affected different age classes and there are reliable baseline age structure data available for the population being assessed.

(iii) Mortality from single incidents may be used to estimate changes in populations only when there are available baseline population data for the area, so that the proportion lost can be estimated, and when corrections can be made for potential sampling biases, such as natural mortality and factors influencing distribution of carcasses and ability of investigators to find them. Specific techniques for measuring mortality include the following:

(A) Fish mortality in freshwater areas may be estimated from counts of carcasses, using methods and guidelines for estimating numbers of fish killed contained in Part II (Fish-Kill Counting Guidelines) of the "Monetary Values of Freshwater Fish and Fish-Kill Counting Guidelines," American Fisheries Society Special Publication Number 13, 1982 (incorporation by reference, see § 11.18), including use of appropriate random sampling methods and tagged carcasses as identified and discussed in Part II of that publication.

(B) The authorized official may adapt the techniques discussed in paragraph (1) (5) (iii) (A) of this section for counting dead aquatic birds or for counting marine or estuarine fish or birds. Such adaptation will require the documentation of the methods used to avoid sampling biases.

(C) Fish mortality may also be estimated by use of an in situ bioassay technique that is similar to that identified in § 11.62(f)(4)(i)(C) of this part, if the oil or hazardous substance is still present at levels that resulted in injury and if appropriate instream controls can be maintained at control areas.

(6) Plant populations may be measured using standard techniques, such as population density, species composition, diversity, dispersion, and cover,

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(7) Forest and range resources may be estimated by standard forestry and range management evaluation techniques.

(8) Habitat quality may be measured using techniques such as the Habitat Evaluation Procedures (HEP) developed and used by the U.S. Fish and Wildlife Service.

[51 FR 27725, Aug. 1, 1986, as amended at 53 FR 5175, Feb. 22, 1988; 59 FR 14283, Mar. 25, 1994]

### § 11.72 Quantification phase—baseline services determination.

(a) *Requirements.* The authorized official shall determine the physical, chemical, and biological baseline conditions and the associated baseline services for injured resources at the assessment area to compare that baseline with conditions found in § 11.71 of this part.

(b) *General guidelines.* Baseline data shall be selected according to the following general guidelines:

(1) Baseline data should reflect conditions that would have been expected at the assessment area had the discharge of oil or release of hazardous substances not occurred, taking into account both natural processes and those that are the result of human activities.

(2) Baseline data should include the normal range of physical, chemical, or biological conditions for the assessment area or injured resource, as appropriate for use in the analysis in § 11.71 of this part, with statistical descriptions of that variability. Causes of extreme or unusual value in baseline data should be identified and described.

(3) Baseline data should be as accurate, precise, complete, and representative of the resource as the data used or obtained in § 11.71 of this part. Data used for both the baseline and services reduction determinations must be collected by comparable methods. When the same method is not used, comparability of the data collection methods must be demonstrated.

(4) Baseline data collection shall be restricted to those data necessary for conducting the assessment at a reasonable cost. In particular, data collected should focus on parameters that are directly related to the injuries quantified

in § 11.71 of this part and to data appropriate and necessary for the Damage Determination phase.

(5) The authorized official may use or authorize for use baseline data that are not expected to represent fully the baseline conditions, subject to the following requirements:

(i) The authorized official shall document how the requirements of this paragraph are met:

(ii) These substitute baseline data shall not cause the difference between baseline and the conditions in the assessment area to exceed the difference that would be expected if the baseline were completely measured; and

(iii) The authorized official has determined that it is either not technically feasible or not cost-effective, as those phrases are used in this part, to measure the baseline conditions fully and that these baseline data are as close to the actual baseline conditions as can be obtained subject to these limitations.

(c) *Historical data.* If available and applicable, historical data for the assessment area or injured resource should be used to establish the baseline. If a significant length of time has elapsed since the discharge or release first occurred, adjustments should be made to historical data to account for changes that have occurred as a result of causes other than the discharge or release. In addition to specialized sources identified in paragraphs (g) through (k) of this section, one or more of the following general sources of historical baseline data may be used:

(1) Environmental Impact Statements or Environmental Assessments previously prepared for purposes of the National Environmental Policy Act (NEPA), 42 U.S.C. 4321-4361, similar documents prepared under other Federal and State laws, and background studies done for any of these documents;

(2) Standard scientific and management literature sources appropriate to the resource;

(3) Computerized data bases for the resource in question;

(4) Public or private landholders in the assessment area or in neighboring areas;

(5) Studies conducted or sponsored by natural resource trustees for the resource in question;

(6) Federally sponsored research identified by the National Technical Information Service;

(7) Studies carried out by educational institutions; and

(8) Other similar sources of data.

(d) *Control areas.* Where historical data are not available for the assessment area or injured resource, or do not meet the requirements of this section, baseline data should be collected from control areas. Historical data for a control area should be used if available and if they meet the guidelines of this section. Otherwise, the baseline shall be defined by field data from the control area. Control areas shall be selected according to the following guidelines, and both field and historical data for those areas should also conform to these guidelines:

(1) One or more control areas shall be selected based upon their similarity to the assessment area and lack of exposure to the discharge or release;

(2) Where the discharge or release occurs in a medium flowing in a single direction, such as a river or stream, at least one control area upstream or upcurrent of the assessment area shall be included, unless local conditions indicate such an area is inapplicable as a control area;

(3) The comparability of each control area to the assessment area shall be demonstrated, to the extent technically feasible, as that phrase is used in this part;

(4) Data shall be collected from the control area over a period sufficient to estimate normal variability in the characteristics being measured and should represent at least one full cycle normally expected in that resource;

(5) Methods used to collect data at the control area shall be comparable to those used at the assessment area, and shall be subject to the quality assurance provisions of the Assessment Plan;

(6) Data collected at the control area should be compared to values reported in the scientific or management literature for similar resources to demonstrate that the data represent a normal range of conditions; and

(7) A control area may be used for determining the baseline for more than one kind of resource, if sampling and data collection for each resource do not interfere with sampling and data collection for the other resources.

(e) *Baseline services.* The baseline services associated with the physical, chemical, or biological baseline data shall be determined.

(f) *Other requirements.* The methodologies in paragraphs (g) through (k) of this section shall be used for determining baseline conditions for specific resources in addition to following the general guidelines identified in paragraphs (a) through (e) of this section. If a particular resource is not being assessed for the purpose of the Damage Determination phase, and data on that resource are not needed for the assessment of other resources, baseline data for the resource shall not be collected.

(g) *Surface water resources.* (1) This paragraph provides additional guidance on determining baseline services for surface water resources. The general guidance provided in paragraphs (a) through (f) of this section should be followed before beginning any work described in this paragraph.

(2) Applicable and available historical data shall be gathered to determine baseline conditions for the surface water resource at the assessment area. If deemed inadequate for determining baseline conditions, such data shall be used to the extent technically feasible, as that phrase is used in this part, in designating the control areas described in paragraph (g)(3) of this section for the surface water resource determined to be injured.

(3) Control areas shall be selected for the surface water resource subject to the general criteria in paragraph (d) of this section and additional criteria as follows:

(i) For each injured stream or river reach, a control area shall be designated consisting of a stream or river reach of similar size, that is as near to the assessment area as practical and, if practical, that is upstream or upcurrent from the injured resource, such that the channel characteristics, sediment characteristics, and streamflow characteristics are similar to the injured resource and the water

and sediments of the control area, because of location, have not been exposed to the discharge or release.

(ii) For each injured standing water body, such as a marsh, pond, lake, bay, or estuary, a control area shall be designated consisting of a standing water body of similar size that is as near to the assessment area as practical, such that the sediment characteristics and inflow-outflow characteristics of the control area are similar to the injured resource and the water and sediments of the control area, because of location, have not been exposed to the discharge or release.

(4)(i) Within the control area locations shall be designated for obtaining samples of water and sediments.

(ii) The water discharge, stage, or tidal flux shall be measured and representative water and sediments collected as follows:

(A) Measure stage, water discharge, and tidal flux as appropriate at the same time that water and sediment samples are collected; and

(B) Obtain comparable samples and measurements at both the control and assessment areas under similar hydraulic conditions.

(iii) Measurement and samples shall be obtained as described in this paragraph in numbers sufficient to determine:

(A) The approximate range of concentration of the substances in water and sediments;

(B) The variability of concentration of the substances in water and sediments during different conditions of stage, water discharge, or tidal flux; and

(C) The variability of physical and chemical conditions during different conditions of stage, water discharge, or tidal flux relating to the transport or storage of the substances in water and sediments.

(5) Samples should be analyzed from the control area to determine the physical properties of the water and sediments, suspended sediment concentrations in the water, and concentrations of oil or hazardous substances in water or in the sediments. Additional chemical, physical, or biological tests may

be made, if necessary, to obtain otherwise unavailable data for the characteristics of the resource and comparison with the injured resource at the assessment area.

(6) In order to establish that differences between surface water conditions of the control and assessment areas are statistically significant, the median and interquartile range of the available data or the test results should be compared using the Mann-Whitney and ranked squares tests, respectively.

(7) Additional tests may be made of samples from the control area, if necessary, to provide otherwise unavailable information about physical, chemical, or biochemical processes occurring in the water or sediments relating to the ability of the injured surface water resource to recover naturally.

(h) *Ground water resources.* (1) This paragraph provides additional guidance on determining baseline services for ground water resources. The general guidance provided in paragraphs (a) through (f) of this section should be followed before beginning any work described in this paragraph.

(2) Applicable and available historical data shall be gathered to determine baseline conditions for the ground water resource at the assessment area. If deemed inadequate for determining baseline conditions, such data shall be used to the extent technically feasible, as that phrase is used in this part, in designating the control areas described in paragraph (h)(3) of this section for the ground water resource determined to be injured.

(3) A control area shall be designated subject to the general criteria in paragraph (d) of this section and as near to the assessment area as practical, such that, within the control area, geological materials, geohydrological units, and hydrologic conditions are similar to the assessment area, and ground water resources are not exposed to substances from the discharge or release.

(4) Within the control area, wells shall be identified or drilled, designated as control wells, to obtain representative ground water samples for analysis. The location, depth, and number of control wells and the number of ground water samples collected should

be sufficient to estimate the vertical and lateral variation in concentration of the substances in both the unsaturated zone and in ground water from geohydrologic units similar to units tested in the assessment area.

(i) Representative water samples from each control well shall be collected and analyzed. The analyses should determine the physical and chemical properties of the ground water relating to the occurrence of oil or hazardous substances.

(ii) If the oil or hazardous substances are commonly more concentrated on geologic materials than in ground water, representative samples of geologic materials from aquifers and the unsaturated zone as appropriate should be obtained and chemically analyzed. The location, depth, and number of these samples should be sufficient to determine the vertical and lateral variation in concentration of the oil or hazardous substances absorbing or otherwise coating geologic materials in the control area. These samples may also be analyzed to determine porosity, mineralogy, and lithology of geologic materials if these tests will provide otherwise unavailable information on storage or mobility of the oil or hazardous substances in the ground water resource.

(5) In order to establish that differences between ground water conditions of the control and assessment areas are statistically significant, the median and interquartile range of available data or the test results from similar geohydrologic units should be compared using the Mann-Whitney and ranked squares test, respectively.

(6) Additional tests may be made of samples from the control area, if necessary, to provide otherwise unavailable information about chemical, geochemical, or biological processes occurring in the ground relating to the ability of the injured ground water resource to recover naturally.

(i) *Air resources.* (1) This paragraph provides additional guidance on determining baseline services for air resources. The general guidance provided in paragraphs (a) through (f) of this section should be followed before beginning any work described in this paragraph.

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(2) Applicable and available historical data shall be gathered on ambient air quality and source emissions to determine baseline conditions for the air resource. These historical data may be used to determine baseline conditions if the data satisfy the general guidelines in paragraph (d) of this section and if all the following criteria are met:

(i) The methodology used to obtain these historical data would detect the oil or hazardous substance at levels appropriate for comparison to the concentrations measured in § 11.71 of this part;

(ii) The effect of known or likely emission sources near the assessment area other than the source of the discharge or release can be identified or accounted for in the historical data; and

(iii) The historical data show that normal concentrations of the oil or hazardous substance are sufficiently predictable that changes as a result of the discharge or release are likely to be detectable.

(3) If historical data appropriate to determine baseline conditions at the assessment area are lacking, one or more control areas, as needed, shall be designated subject to the general criteria of paragraph (d) of this section and the following additional factors, which shall also be considered in establishing a monitoring schedule;

(i) Applicable and available historical data shall be used to the extent technically feasible, as that phrase is used in this part, in designating control areas or, lacking historical data, the factors in paragraph (i)(3)(iii) of this section shall be considered;

(ii) Control areas shall be spatially representative of the range of air quality and meteorological conditions likely to have occurred at the assessment area during the discharge or release into the atmosphere; and

(iii) The following additional factors shall be considered:

(A) The nature of the discharge or release and of potential alternative sources of the oil or hazardous substance, including such factors as existing sources, new sources, intermittent sources, mobile sources, exceptional

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events, trends, cycles, and the nature of the material discharged or released;

(B) Environmental conditions affecting transport, such as wind speed and direction, atmospheric stability, temperature, humidity, solar radiation intensity, and cloud cover; and

(C) Other factors, such as timing of the discharge or release, use patterns of the affected area, and the nature of the injury resulting from the discharge or release.

(4)(i) The preferred measurement method is to measure air concentrations of the oil or hazardous substance directly using the same methodology employed in § 11.71 of this part.

(ii) Nonspecific or chemical compound class methodologies may be used to determine baseline generically only in situations where it can be demonstrated that measuring indicator substances will adequately represent air concentrations of other components in a complex mixture.

(j) *Geologic resources.* (1) This paragraph provides additional guidance on determining baseline services for geologic resources. The general guidance provided in paragraphs (a) through (f) of this section should be followed before beginning any work described in this paragraph.

(2) Applicable and available historical data shall be gathered to determine baseline conditions for the geologic resource at the assessment area. If deemed inadequate for determining baseline conditions, such data shall be used to the extent technically feasible, as that phrase is used in this part, in designating the control areas described in paragraph (j)(3) of this section for the geologic resource determined to be injured.

(3) Control areas shall be selected for geologic resources subject to the general criteria in paragraph (d) of this section and additional criteria as follows:

(i) Similarity of exposed soil or geologic material in the assessment area with the geologic resource in the control area should be the primary factor in selecting the control area. Other factors, including climate, depth of ground water, vegetation type and area covered, land slope and land area, and

hydraulic gradients and spatial relation to source should be comparable to the assessment area.

(ii) The control area shall be selected such that the geologic resource in the control area is not exposed to the discharge or release.

(4)(i) A sufficient number of samples from unbiased, randomly selected locations in the control area shall be obtained in order to characterize the areal variability of the parameters measured. Each sample should be analyzed to determine the physical and chemical properties of the geologic materials relating to the occurrence of the oil or hazardous substance. Additional chemical, physical, or biological tests may be made, if necessary, to obtain otherwise unavailable data for the characterization and comparison with the injured resource at the assessment area.

(ii) The mean and standard deviation of each parameter measured shall be used as the basis of comparison between the assessment and control areas.

(k) *Biological resources.* (1) This paragraph provides additional guidance on determining baseline services for biological resources. The general guidance provided in paragraphs (a) through (f) of this section should be followed before beginning any work described in this paragraph.

(2) Applicable and available historical data shall be gathered to determine baseline conditions for the biological resource at the assessment area and should include both population and habitat data if available. These data may be derived from the data sources identified in paragraph (c) of this section, as well as from the following:

(i) Aerial photographs or maps showing distribution and extent of habitat types or other biological resources before the discharge or release;

(ii) Biological specimens in systematic museum or herbarium collections and associated records, including labels and collectors' field notes; and

(iii) Photographs showing the nature of the habitat before the discharge or release when the location and date are well documented.

(3)(i) Control areas shall be selected for biological resources subject to the

general criteria in paragraph (d) of this section and additional criteria as follows:

(A) The control area shall be comparable to the habitat or ecosystem at the assessment area in terms of distribution, type, species composition, plant cover, vegetative types, quantity, and relationship to other habitats;

(B) Physical characteristics of the control and assessment areas shall be similar; and

(C) If more than one habitat or ecosystem type is to be assessed, comparable control areas should be established for each, or a control area should be selected containing those habitat types in a comparable distribution.

(ii) To the extent they are available, historical data should be gathered and used for the control area. Lacking adequate historical data for both the control and assessment areas, the control areas shall be used for the following purposes, as appropriate to the quantification:

(A) To measure baseline biota population levels or habitat or ecosystem quality, as discussed in § 11.71(l) of this part; and

(B) To measure the natural frequency, if any, of the injury being assessed in unaffected populations or to demonstrate the lack of that injury in unaffected populations if these have not been done for purposes of the Injury Determination, and if needed for purposes of the Quantification.

(4) In addition, a control area should be used to collect control specimens, as needed, for the Injury Determination procedures.

(5) The identity of species for which Damage Determinations will be made or that play an important role in the assessment shall be confirmed except in the case where collecting the specimens of a species is likely to compromise the restoration of the species. One or more of the following methods shall be used:

(i) Specimens of the species shall be provided to an independent taxonomist or systematic biologist, who has access to a major systematic biology collection for that taxon, and who shall provide written confirmation of their identity to the species level;

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(ii) A reference collection of specimens of the species, prepared and preserved in a way standard for systematic collections for that taxon, shall be maintained at least through final resolution of the damage action at which time it should be transferred to a major systematic biology collection; or

(iii) In the case of a species where collecting specimens is likely to compromise the recovery or restoration of that species population, the authorized official shall determine and use an alternative method for confirming species identity that will be consistent with established management goals for that species.

[51 FR 27725, Aug. 1, 1986, as amended at 53 FR 5175, Feb. 22, 1988; 59 FR 14283, Mar. 25, 1994]

### § 11.73 Quantification phase—resource recoverability analysis.

(a) *Requirement.* The time needed for the injured resources to recover to the state that the authorized official determines services are restored, rehabilitated, replaced, and/or the equivalent have been acquired to baseline levels shall be estimated. The time estimated for recovery or any lesser period of time as determined in the Assessment Plan must be used as the recovery period for purposes of § 11.38 and the Damage Determination phase, §§ 11.80 through 11.84.

(1) In all cases, the amount of time needed for recovery if no restoration, rehabilitation, replacement, and/or acquisition of equivalent resources efforts are undertaken beyond response actions performed or anticipated shall be estimated. This time period shall be used as the “No Action-Natural Recovery” period for purposes of § 11.82 and § 11.84(g)(2)(ii) of this part.

(2) The estimated time for recovery shall be included in possible alternatives for restoration, rehabilitation, replacement, and/or acquisition of equivalent resources, as developed in § 11.82 of this part, and the data and process by which these recovery times were estimated shall be documented.

(b) *Restoration not feasible.* If the authorized official determines that restoration will not be technically feasible, as that phrase is used in this part, the reasoning and data on which

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this decision is based shall be documented as part of the justification for any replacement alternatives that may be considered or proposed.

(c) *Estimating recovery time.* (1) The time estimates required in paragraph (a) of this section shall be based on the best available information and where appropriate may be based on cost-effective models. Information gathered may come from one or more of the following sources, as applicable:

(i) Published studies on the same or similar resources;

(ii) Other data sources identified in § 11.72 of this part;

(iii) Experience of managers or resource specialists with the injured resource;

(iv) Experience of managers or resource specialists who have dealt with restoration for similar discharges or releases elsewhere; and

(v) Field and laboratory data from assessment and control areas as necessary.

(2) The following factors should be considered when estimating recovery times:

(i) Ecological succession patterns in the area;

(ii) Growth or reproductive patterns, life cycles, and ecological requirements of biological species involved, including their reaction or tolerance to the oil or hazardous substance involved;

(iii) Bioaccumulation and extent of oil or hazardous substances in the food chain;

(iv) Chemical, physical, and biological removal rates of the oil or hazardous substance from the media involved, especially as related to the local conditions, as well as the nature of any potential degradation or decomposition products from the process including:

(A) Dispersion, dilution, and volatilization rates in air, sediments, water, or geologic materials;

(B) Transport rates in air, soil, water, and sediments;

(C) Biological degradation, depuration, or decomposition rates and residence times in living materials;

(D) Soil or sediment properties and adsorption-desorption rates between soil or sediment components and water or air;